Mechelectiv

VOL. 15 NO. 5

IN THIS ISSUE:

SCHOOL OF ENGINEERING
THE GEORGE WASHINGTON UNIVERSITY

APRIL 1956

Robert T. Blake, Class of '49
speaks from experience when he says,

"At U.S. Steel, the opportunities are unlimited."

Bob Blake had his first experience in steel mills working there during summer vacations from college. After receiving his B.S. degree in Electrical Engineering, he became an operating trainee in U.S. Steel's Irvin Works. During his training program, his background and versatility were used by the Training Division to develop a training program for Electrical Maintenance employees. By the end of 1951, Mr. Blake had become a Foreman with experience in both Cold Reduction Maintenance and the Galvanizing Department.

Effort is made to have young engineers obtain varied experience before devoting themselves to one field. Mr. Blake feels that, "An engineering graduate has practically no ceiling provided he has the right attitude and is willing."

Promoted again in 1954, Mr. Blake is now Foreman—Electric Shop in Central Maintenance. Supervising a crew of 40 men, he is responsible for electrical construction work, maintenance and crane wiring. Mr. Blake feels he is in "an interesting and challenging field of work." He has found that "U.S. Steel is a highly desirable employer in this most basic of all industries."

If you are interested in a challenging and rewarding career with United States Steel and feel you are qualified, further information is available from your college placement director. Or, we will gladly send you our informative booklet, "Paths of Opportunity." Just write to United States Steel Corporation, Personnel Division, Room 1622, 525 William Penn Place, Pittsburgh 30, Pa.

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SCIENCE AND ENGINEERING

AT LOCKHEED MISSILE SYSTEMS DIVISION

Charles W. Goedecke, Electronic Design Group Engineer, Emerson M. Hoyt, Electronic Research Specialist, and George L. Larse, head of Electronic Systems Development in the Flight Test Electronics Department, discuss important aspects of new electronic command decoding devices for missile guidance systems.

MISSILE ELECTRONICS

DATA TRANSMISSION LINKS SYSTEMS AND COMPONENTS

The advancement of missile systems technology can be measured to a great extent by increasing demands imposed on the ability of electronic systems and components engineers.

Electronic problems encountered in hypersonic flight, particularly at high ambient temperatures, require creative efforts and coordination of a high order from engineers in fields of radar, guidance, telemetry and instrumentation.

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Data transmission and telemetry involving development and application of antennas, transducers, FM oscillators, VHF transmitters and receivers.

Those possessing keen interest in both systems and component development are invited to write.

Lockheed **MISSILE SYSTEMS DIVISION** *research and engineering staff*

LOCKHEED AIRCRAFT CORPORATION **VAN NUYS · CALIFORNIA**

Mechelectiv

VOL. 15 APRIL 1956 NO. 5

SCHOOL OF ENGINEERING, THE GEORGE WASHINGTON UNIVERSITY

IN THIS ISSUE

DEPARTMENTS

ON OUR COVER

Eighteen all-welded steel rigid frames form the support for the roof of a 200 by 400 feet indoor practice field for Ohio State University. The almost two-acre dirt floor will be used for indoor practice of football, baseball and track.

Lincoln Electric Company Photo

FRONTISPIECE

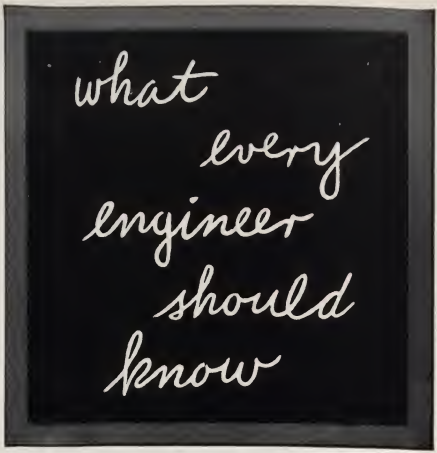
The scoop of the world's largest power shovel nearly dwarfs the men working on it. The shovel, capable of a 90 ton "bite" is 100 times larger than the average power shovel and half again as large as any other. The shovel is operated by electric motors powered by a portable 5000-kva substation. Built by the Marion Power Shovel Co., it recently began coal stripping for the Hanna Coal Co. at Cadiz, Ohio. Electrical controls and power equipment are built by General Electric.

Photo courtesy of General Electric

Published at the George Washington University by direction of the Engineers' Council. Published six times during the school year in October, November, December, March, April, and May. Entered as second class matter March 6, 1951, at the Post Office at Washington, D. C., under the act of March 3, 1879. Address communications to Mechelectiv Magazine, Davis-Hodgkins House, George Washington University, Washington 6, D. C. or telephone STerling 3-0250, Extension 528.

CHANGE OF ADDRESS: Send your new address at least 30 days before the date of the issue with which it is to take effect.

Subscription Price: Two Dollars



about the future at MARTIN

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MARTIN
BALTIMORE

EDITORIAL:

Back-up or Backdown

As June and Graduation approach for engineering students all over the country, the time approaches for all editors to take a tongue-in-cheek pot shot at the future. To make any prediction, or even a wild guess, would be sheer folly, for the field of engineering is advancing at too rapid a pace.

When the graduate leaves college with his Bachelor's degree, he has, so to speak, just begun his education. The need for higher education on the graduate level is evident in the number of graduate programs sponsored by the industrial grants of business. Universities are getting more and more money grants for graduate programs, and there is no end in sight for the need of highly trained specialists. With this extensive need for technical manpower goes the need for scientific education, which is, at the present time, sadly lacking in our secondary schools. To what end does this point? To answer this, we must keep in mind that an engineer is no better than the technicians who back him up: the men who service, install and baby his brainchild. With the advancing state of technology, a technician can no longer learn his trade by some sort of apprentice system; he has to have schooling.

This technical schooling must be able to instill an understanding of the basic principles involved in the particular field of interest, yet must be practical enough to be feasible. But if scientific training is lacking, how can this army of technicians be developed? At the present stage of the game, the answer seems to be to use the engineers themselves. Just what are we short of: engineers, or highly-trained technicians? If engineers were used as engineers, would there really be such a shortage of manpower in the technical fields?

The problem is then twofold: there is a shortage of engineers and there is a shortage of technically trained men. To start at the root of the problem, our secondary schools need a "shot in the arm" to boost their scientific level. This problem, however, is quite well known by all college educators; evidence the opinion of our own dean on the faculty page two months ago.

To answer the problem on the college level is not simple, for it involves some of the greatest educational disputes of the engineering world. First: The five-year course is almost inevitable. Only so many classroom hours can be put into eight semesters or twelve quarters, and if the engineer is to be "humanized" or made technically more proficient, courses will have to be added to his already crowded program. Second: A two-year course of basic mathematics and physics is needed to develop the required technical men to back up the engineers. Shall we back up our engineers, or shall we misuse their education and make some of them backdown?

FACULTY PAGE

THE ENGINEER AND SOCIETY---ARE THEY CONGENIAL ?

By Dr. Jack E. Walters,
Professor of Engineering Administration

Some non-engineers feel that engineers in general are non-social, that the engineer and society are not congenial. The root of the word engineer is "engine." Earlier the engineer was thought of as a builder of engines and structures now also of methods and their administration. Engineers do like to work with things mechanical, electrical, civil and chemical, but they may like also to work with people and to administrate them. They can learn to be more "social" and participate in community activities.

Today 40% of the industrial executives in this country are or have been engineers (according to the E. C. P. D. - Engineers Council for Professional Development). Two thirds of the engineers who started in technical work after college were performing functions twenty years later which could be called administration. As the engineer grows in his specialization he often finds that he has administrative functions added to his duties. It is difficult for a non-engineer to administer engineers. yet the engineering administrator needs to learn administration and become more interested in human relations and "social" matters. Some companies are hiring more non-engineers for some jobs formerly held by engineers. One reason is that they cannot hire enough engineers because of the scarcity. However, that scarcity focuses attention upon the administration of engineers and their social attitudes and values. What should be the relation of the engineer to society?

The engineer, from his freshman year in college and before, has been educated in the use of the engineering or scientific method of collecting the facts, classifying those facts, basing his solutions on those facts and testing his solution. If he applies the same method to his administration, human, and social problems he should be able to solve those problems better than the non-engineer, because of his inbred ability with that method.

Engineers often have difficulty applying that same scientific method to their administrative and social problems. However, with added education in engineering administration they can become better engineering admin-

(Please turn to Page 28)

A Painting—$E=MC^2$ Gustilo

$E=MC^2$

Beneath the stands, where, in a brighter day,
Gay students urged their colleagues down the field,
Locked in the dark, the secret monster lay.
Product of toil by men who would not yield.
For years the Sages strived to find a way
The tortured atom's mighty power to wield;
Controlled by rods to quench the deadly ray,
Until all men were safe behind their shield.
Now was the hour, the graphite was withdrawn,
Within a fiercer heat proclaimed the birth
Of Atom's Age of fear. For Man the pawn
Of War Gods faced his end, and the whole earth
Foresaw its swift destruction. 'Tis at dawn
Hope for a peaceful future proved Man's worth.

W. J. Mayo - Wells

Instrument Making:

AN ENGINEERING SPECIALTY

Edited by Ray Sullivan, BEE '58

An optical collimator system which can level to the nearest second of arc. A 10-second theodolite is shown in position for sighting into the collimator telescope for calibration.

Alpha Instrument Photo

Editors Note: This article, second in the MECHELECIV series on local industry, presents a unique service found in the Washington area. Contrary to popular opinion, the government does not have a monopoly on engineering talent in the Washington area, but many firms, from consultants to manufacturers flourish within sight of the Washington Monument.

Information for this article was furnished by John Kusner, Technical Manager of Alpha Instrument Co., Inc. and a former student of the GWU School of Engineering.

Wherever a surveyor locates a boundary, an engineer aligns a structure, or an astronomer measures a star - wherever man makes a measurement - he is dependent upon a measuring tool, an instrument. Man's dependency upon instruments grows constantly more widespread as modern engineering and science are based increasingly more on *precise measurements.*

So accustomed are we in engineering to the continual taking of measurements that we more often than not assume the instruments we use for granted. Imagine the futility of attempting close measurement without instruments: to determine long or inaccessable distances with our sense of sight alone, to scale the magnitude of sounds with only our sense of hearing, to "guesstimate" the hardness of metals by touch, or even to perform chemical analyses by our senses of taste and smell.

So completely have technical instruments been taken for granted that their source has receded into obscurity.

Among engineers and scientists, few, perhaps, have ever paused in their routine of measurement-taking, design-work, or analysis of data to contemplate the origin of an instrument. Fewer still have perceived beyond its purchase, behind its manufacture - the instrument shop where problems of measurement in science and engineering are studied and their solution returned in the design and construction of instrument prototypes.

The functions of an instrument shop require its specialization in technical versatility more than in facilities for high production rates.

It is evident that commercially manufactured instruments routinely used in science and engineering, such as transits and microscopes, must first be designed, then developed in prototype form. Thus the production of a factory is necessarily dependent on instrument shop services.

Not limited to manufacturers, these instrument shop services are readily applicable to special and individual problems of measurement and control. Not infrequently, the work of engineers and scientists reaches a limit beyond which no progress can be gained without special instrumentation.

Further, the instrument shop can effectively render a consultation service to scientists and engineers in advice on their application of standard or special instruments. Often such consultation leads to the design and construction of a special instrument to solve a unique measuring problem. Sometimes this service culminates in the sale of instruments of standard manufacture. Progressively, technical people prefer to purchase their instruments from a firm specialized in technical instrument work. Such a firm has not only an engineering knowledge of the applications of the instruments but can also repair and service them, and in certification of instrument accuracy can inspire the operator's confidence.

A well-equipped instrument shop can efficiently and accurately perform the routine servicing and adjustment of instruments submitted periodically for checking. This service is best performed regularly to instruments in constant use.

Now that we have an idea of the purposes and functions of an instrument shop let's have a look into one. Fortunately, we have one very near us; The Alpha Instrument Co., Inc., is just off the edge of the campus.

The exact work of an instrument shop often depends on the needs of its locality. A major portion of the work at Alpha is the repair and calibration of surveying instruments for the engineers, surveyors, and contractors of the greater Washington area. The use of these instruments is widespread, not only in outdoor activities but even by physicists to measure deflections or by aircraft factories for jig alignment and optical tooling for assembly.

The most common service provided is that of cleaning and readjusting levels, transits, and theodolites. The cleaning process requires the complete dismantling of the instrument followed by careful washing of each part in solvent. The parts are then inspected for damage and wear after which any necessary repair or replacement is performed, the instrument reassembled from the base up, and the bearing surfaces lubricated.

Often instrument parts have to be repaired and replaced and even new parts have to be fitted - this usually requires machinework. Often the instrument shop must machine parts which the manufacturer cannot replace for an obsolete instrument. Alpha has all of the customary machine tools which one would expect to find in an instrument shop and a few more besides. A linear dividing engine is utilized for precise linear measuring and ruling of scales and verniers. A radial dividing engine for the ruling of graduated circles is currently being reconstructed.

A linear dividing engine which can be read to the nearest half-micron. It is used both for the engraving of reticles, scales, and verniers and for precise linear measurements. Alpha Instrument Photo

After assembly an instrument must be adjusted. This requires calibration facilities. Alpha maintains two separate calibration systems. The first system involves an isolated support pier bearing a universal head for clamping to all types of surveying instruments. The pier is based on its own massive foundation which is floated in fill dirt for cushioning from city vibrations. In use, standard targets and illuminated scales are sighted from the pier for azimuth and elevation adjustments.

The second system employs an optical collimator. (See opposite page.) This system is the more modern and efficient. The basic collimator is simply a large and accurate telescope. Instead of the telescope being used for looking, the eyepiece is replaced with an illuminated crosswire reticle. The crosswires are focused to project their image along *parallel* beams of light. The supports of the adjusted telescope are leveled so that, secondly, the image of the crosswires is projected along a *leveled* line of sight. A good collimator can furnish these two adjustment standards to a high degree of precision. The surveying instrument is sighted into the objective lens of the collimator for adjustment. When its crosswires are brought coincident to those observed in the collimator, the line of sight of the surveying instrument is brought parallel to that of the previously adjusted collimator and its settings are *duplicated*. This adjustment is both rapid and precise.

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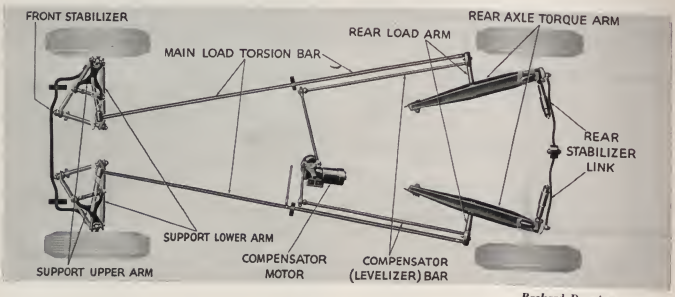
A Production First:

THE PACKARD TORSION BAR

By Orron Kee, B.M.E. '57



Packard Drawing

The basic Packard torsion-bar suspension system

Orron Kee, a junior in mechanical engineering, presents here his first contribution to these pages. This article was originally presented as a Sigma Tau paper; Orron was the winner of the freshman Sigma Tau award for 1953-54. He is a member of Sigma Tau and Theta Tau, and has served as secretary of the Engineers' Council.

Ever since the first horseless carriage was built, engineers and designers have been plagued with the knotty problem of proper ride control for automobiles. At first, the problem was to make the car ride softly enough on the rough and rutted roads so that the driver's teeth weren't shaken out. Then as the roads improved and the springs became softer, a new problem arose: these soft springs allowed the car to "hit bottom" on bumps, lean on corners, squat on the takeoff, and dive when braking. The springs were fine for normal driving, but too flexible for the extremes of driving that occur all to frequently.

Last year Packard solved these ride problems, not by modifying a conventional set of springs, but by introducing a whole new suspension system using torsion bars. However, before discussing Packard's application of torsion bars, it would be well to look into the background of torsion bars.

To begin with, torsion bars are steel rods which are used as springing devices in automobiles. In general use, one end of the bar is connected to one wheel of the car while the other end is attached rigidly to the automobile's frame. When the wheel is deflected by a bump, the torsion bar is twisted about its axis, and after the bump is passed, the bar unwinds. This twisting action of the torsion bar is very similar to the flexing of a conventional coil or semi-elliptic leaf spring. Thus, the principle of the torsion bar is quite simple.

The use of torsion bars is far from a recent development. Torsion bars have been used for many years on racing cars, experimental models, and on several production cars. The French Citroen has had torsion bars on every model of the Series 11 and 15 since 1934. Many other European cars also use torsion bars, as is shown in the table. Incidentally, the fact that two of Europe's cheapest cars, the Volkswagen and the Morris.

Automobile	*Location of Torsion Bars*
BMW	front and rear
Bristol	rear
Citroen 11 and 15	front and rear
Daimler Six	front
Jaguar Mark VII & XK 140	front
Lanchester	front
Lagonda	rear
Mercedes-Benz 300	rear
Morris	front
Panhard	rear
Pegaso	front and rear
Porsche	front and rear
Riley	front
Volkswagen	front and rear
Wolseley	front

use torsion bars is an indication that torsion bars are no more expensive than conventional springs. In the United States, Kaiser and Studebaker produced experimental cars with torsion bars in 1946 and 1947, and General Motors' experimental gas turbine car, the Firebird, is equipped with torsion bars. In addition to automobile use, torsion bars have been employed successfully on tandem axle Fruehauf trailers since 1945. Hence, the use of torsion bars is by no means new, but the Packard is the first American production car to use torsion bars.

The Packard suspension is unique in that the torsion bars are not attached to the frame, but link the front and rear wheels together; and, in addition, a load leveling system acts in conjunction with the torsion bars. The two main torsion bars are nine feet in length and one inch in diameter, and they are made of shot-peened, prestressed, alloy steel. Each main bar runs from a lever connected to the inner side of one front wheel, through the side rail of the frame, and to a lever mounted on the outside of the corresponding rear axle torque arm which pivots the rear axle. (See figure.) All four wheels are cushioned by conventional shock absorbers. The arrangement of the torsion bars is such that when the front wheel is moved up, the twist is transmitted through the bar, and the rear wheel on the same side of the car is moved down. This action permits the car to ride smoothly and to stay level at one particular load.

If the Packard had only torsion bars and shock absorbers, it would ride lower when the load was increased, just as a conventional car does. To keep the Packard level at all times, Packard designers added a "load levelizer" device to the chassis. The load levelizer consists of two auxiliary torsion bars which link the levers on the two rear torque arms to a compensator motor located at the center of the chassis. The compensator motor, which is controlled by a "load senser" switch on one of the main torsion bars, twists the auxiliary bars which raise or lower the car as the load on the main bars is increased or decreased. The car thus remains level and at the same height at all times. The wheels can deflect through the same distance, no matter what the load; consequently, the car seldom "bottoms" on bumps.

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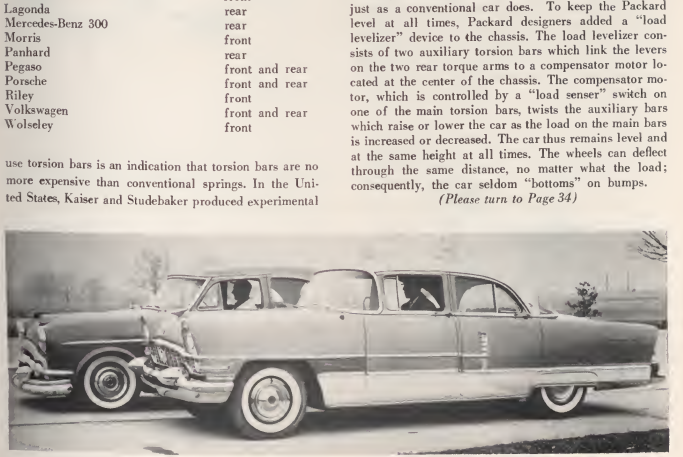

HARD BRAKING from 20 miles per hour causes the 1954 model with conventional suspension to dive as the brakes are applied. The 1955 model in the foreground shows only a slight lowering of the whole car for the same braking.
—*Packard Photo.*

THE ENGINEER and DIPLOMACY

By Fred Hallberg, B.E.E. '58

drawings by Lenore Alexander

Fred Hallberg's record in electronics is a long one, including Navy schools, the University of Connecticut, and Bliss Electrical School. At present Fred is employed at the Naval Research Laboratory and is completing his studies at George Washington. On campus he is a member of Sigma Tau and A.I.E.E.-I.R.E.

The majority of our engineering graduates undoubtably have the necessary training and basic knowledge to cope with most technical engineering problems but the question often arises as how many of these graduates will have the ability to successfully deal with problems in human engineering?

Diplomacy is defined as artful management in securing advantages without arousing hostility. Human engineering could be described as the application of the fundamental principles of diplomacy in our every day life.

A man's success or failure in engineering or business depends to a large extent on his ability to win friends. Apparently, industry values this skill in human engineering very highly, since over 80% of a man's earning power is based on this skill, but only 15% to 20% on technical engineering. Few people are born with an inherently likeable manner. Most of us learn by a costly trial and error process; while others never learn.

Two advertisements for electro-mechanical engineers listed salaries of $25,000 and $30,000 per year. In each case the supervision of around 200 employees was involved. The right engineer for the job would have 200 new friends in a short time. Another engineer who had equal or greater technical ability, but was deficient in human engineering ability might quickly lose 200 potential friends and would adversely effect the company's efficiency.

It is a lot easier to be critical of the attitude and actions of others than to be critical of ourselves. Quite often we are unaware of our own shortcomings, even though they are quite obvious to everyone else. An attitude of self-criticism as a means of improving our relations with others is a healthy one and is much easier to take than criticism from another source.

In order to obtain a more objective attitude in our relations toward others one must transcend subjective rationalization to justify erroneous actions. Toward this end, a course of training in this important field of human engineering can be very helpful. A commander would be very reluctant to send untrained troops into the field of battle. A teacher should be equally reluctant to send untrained students into the field of engineering. And yet there are graduates today who enter the field of engineering totally unprepared in the art of getting along with people. So much time is spent in absorbing technical knowledge that there is little time left for absorbing the important social concepts and techniques necessary to promote bilateral relations on a friendly basis with one's associates. Any improvement made in the social attitude of a person could very well produce a wholesome regenerative effect. As an example, suppose a man is undiplomatic in his approach to home problems as well as to those which confront him in his work. The unhappy home life may be reflected in the work life and cause further degeneration of his social attitude. Conversely a sound program of human relations at home can easily become contagious if extended to one's relations on the job and other external contacts.

The writer was recently told a story of human engineering in action at a Pennsylvania steel mill. The foreman on the job was comparatively new and unlike some of the older employees did not know many of the fine points of steel making. One day a flaw developed in the rolling of sheet steel and the foreman didn't have the slightest idea where to begin looking for the trouble. The foreman maintained a sincere and humble attitude in asking several of the men for their advice and ideas on what might be causing the flaw. When one of them said he thought it was caused by a particular roller, he suggested they go together and investigate. When it turned out that the trouble did not occur in the place suggested, the foreman said "I guess we were wrong, let's see if we can figure out what other thing might cause this flaw to develop." A short time later, through renewed effort on the employee's part as well as the foreman, the difficulty was remedied. The employee was then given praise for locating the trouble.

Melville Hopkins of Pennsylvania State University in an article* has discussed the problem of human relations in management and concluded that "Human relations, while not an occult science, contains far more than just 'getting along with people'." The speaker has never met an executive, in general management or in engineering management, who was not able to 'get along with people.' By no means did this mean that these gentlemen had mastered human relations; quite often it simply meant that, because of their position in management, people found it convenient to get along with them.

"Engineering management, then, has the continued responsibility of placing human relations high on its agenda. It must ever be remindful that the function of securing the common economic purpose of the total enterprise cannot be achieved without maintaining the equilibrium of the social organization, so that individuals through contributing their services to this common purpose obtain personal satisfactions that make them willing to cooperate."

Since engineering management is concerned about the human relations problem, it should be doubly important for us to determine ways in which the engineer can obtain the nourishment that is presently lacking in the engineering diet.

One way of obtaining this added training might be to require reading books on human relations problems. Perhaps during the orientation period some practical problems could be presented in an interesting manner. These problems might be taken from actual cases or case studies where application of the fundamental concepts of human engineering were applied in order to solve or at least simplify a technical engineering problem. Since this is not an exact science, basic precepts should be treated flexibly. As the art develops, methods of applying human relations scientifically will be possible.

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*Melville Hopkins in Trans. of the I. R. E. PGEM-2, 25 November 1954.

Keep 'Em Rollin'

By Dick Rumke, B.C.E. '57

Dick Rumke is able to write with authority on the subject of Railroads, for he is an assistant engineer for The Southern Railway Co. Dick has served as treasurer of the student chapter of the A.S.C.E. and is now president. Dick is also a member of Theta Tau on campus and of the National Geographic Society.

One of the spots of drama in early day railroading, and also of present day activities is the "yard." Within the confines of such an area, the sorting and distribution of freight cars goes on around the clock to meet the schedules of America's Railroads.

From the switchman in the yard to the president of the railroad can be heard: "Keep 'em rollin.'" Service to the customer is the prime requisite of the railroads, service that presents such challenges to railroads as modernization, competition, administration and economization. What do these challenges involve? How are they being overcome? What is the engineer's role in meeting these challenges? What are the railroads doing to meet these challenges? It is with these areas that the scope of this article is concerned.

MODERNIZATION. The past ten years have proven to be a dynamic decade in railroading. Ultra-modern railroad classification yards, at costs running well into the millions of dollars, have been and are being designed and built by capable railroad engineers to increase the number of cars handled and reduce the time for classifying same.

Railroad shops have conveyorized and mechanized to become production shops. Terminals are being streamlined with flat roofs for heliports to give rail carriers the added flexibility of army aviation in terms of military defense.

Automation has entered railroading with respect to signal and retarder systems. The signal system, called "Centralized Traffic Control" is designed to accommodate more continuous traffic and tighter schedules over vast distances which require faster construction methods on the part of the engineer to reduce stop-over time.

The weighing of cars has been modernized by the use of electronic devices which enable the weighmaster to obtain weights of cars while they are in motion. Accuracy of weights has been obtained to within two-tenths of one percent of the actual weight.

With higher train speeds, the engineer must build track with better wear and riding qualities by replacing light-weight rail with heavier rail. Track maintenance and replacement have become fully mechanized so that in one pass huge machines may dismantle the track ahead and leave behind completely reworked track ready for high-speed service.

Modernization continues on the railroad. Even today, the railroads are watching with interest the far reaching effect nuclear energy may have upon the railroad. Specifically, since the nuclear energy could be converted into electric power, it might change the motive power from diesel to electric or some modification thereof and create the need for overhead tower structures for the transmission of this power.

Any individual or industry that spends more effort resisting change than in development of new ideas stagnates and cannot survive.

COMPETITION. Just as research has helped the engineer in modernizing the railroad plant, it has also proved to be competitive with respect to other modes of transportation. Stepped up research during the war advanced both aircraft and automotive craft several decades in such features as lighter-weight metals, synthetic rubber and higher octane gasoline. Industry is transporting an ever-increasing tonnage of its own products upon waterways, airways and highways. Pipe lines carry the greater share of petroleum products and the practicability of moving coal through pipe lines is being investigated. Carrier belts for movement overland of bulk material is also being studied.

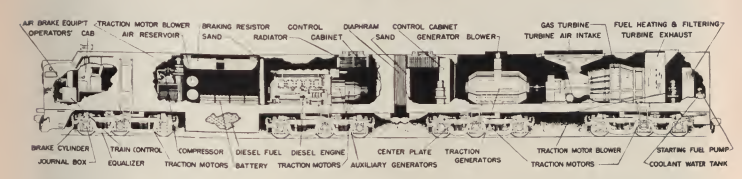
Competition exists among the railroads themselves in securing new industries to locate along their rights-of-way. Locations, facilities and available manpower are factors the engineer must know. He must be able to present such information in suitable form to interest prospective industries. The continual redistribution of rail traffic necessitates rebuilding, rearranging, removing or adding facilities.

It is quite evident that the railroad engineer today must not only take an interest in his own work, but must see what is going on about him, because all other industry is advancing rapidly.

ADMINISTRATION. Under competition, management decisions as to pricing and service become more difficult because the factors involved are more complicated. The very existence of competition makes it imperative that natural economic factors be taken into account by management.

The engineer can no longer isolate himself and deal only with design layouts, cost estimates and preparation of reports. He must have a broad knowledge of all items pertaining to the industry and a detailed knowledge of his own railroad. He should know the nature of his railroad's traffic, the services provided, and any weaknesses or deficiencies in the physical characteristics of the road which detract from service or add to operating costs.

The railroad engineer must be familiar with the records and accounts pertaining to the operating and maintenance costs of his department, with accounting and budgeting procedures and with cost control methods. He must know such costs before he can assemble data to support recommendations for new methods and equipment.



8500 HORSES—Cutaway shows innards of the most powerful locomotive on American rails, being built by General Electric for Union Pacific. Auxiliary diesel engine (for switching) and auxiliary equipment is in front section.

To bring about such attitudes and improvements, the engineer must have an open mind and be receptive to new ideals. He must have the courage to defend his ideas. Whatever the engineer can do to enable his railroad to operate freight trains of greater tonnage at higher sustained speeds will of course, be reflected favorably in the cost of conducting transportation.

The engineer must be able to plan his programs carefully to secure the best use of men and equipment. He must be more familiar with the mechanical side of work equipment because of the continuation of mechanization in construction and maintenance procedures. Concurrent with mechanization will be an increasing use of division, region and system gangs transported and housed in off-track units and their work equipment will similarly be off-track as well.

ECONOMIZATION. How railroad investment and research have teamed up to produce tools and machinery that do a more efficient job is exemplified by the diesel locomotive. The advent of dieselization has made it necessary to enter into train radio communication because ordinary hand and lantern signals could not be recognized due to the longer length of trains and the curves, tunnels and obstructions between the engine and caboose.

Railroads strive for greater efficiency rather than curtail maintenance. Reduced cost of maintenance through mechanized gangs and modern shops, for example, enables the maintenance dollar to go further.

(Please turn to Page 28)


World's most powerful production aircraft engine
The J-57 axial-flow jet engine with afterburner, designed and developed by Pratt & Whitney Aircraft.

McDONNELL F-101 — The Voodoo, an Air Force supersonic fighter that has two J-57 engines with afterburners, is the most powerful jet fighter yet built.

BOEING B-52 — Eight J-57 engines, mounted in pairs, power this all-jet, heavy Air Force bomber.

BOEING 707 — The Stratoliner will usher in commercial travel in the jet age. It is the counterpart of the KC-135, a military tanker-transport powered by four J-57 engines.

CHANCE VOUGHT F8U — Powered by a J-57 with afterburner, the Crusader is the Navy's fastest carrier-based fighter.

The best airplanes... are designed around the best engines

Today's most valuable military aircraft, capable of supersonic or intercontinental flight, include various Air Force and Navy fighters, bombers and transports. Among these are nine types that have a significant feature in common. They all fly on one type of engine — the J-57 turbojet.

Also entrusted to the efficient, dependable operation of Pratt & Whitney Aircraft's jet engines will be the commercial jet transports soon to travel along the air lanes of the world.

The excellence of the J-57 is attributed to the engineering team that has determinedly maintained its leadership in the field of aircraft powerplants. Effort is now being directed toward the improvement of advanced jet and turboprop designs. Still to be anticipated is mastery of current technology's most provocative problem — the successful development of a nuclear aircraft engine.

Many engineering graduates would like to be concerned with the air power of the next generation. One way to fulfill that ambition is to pursue a career alongside the Pratt & Whitney Aircraft engineers who have consistently produced the world's best aircraft engines.

World's foremost designer and builder of aircraft engines

PRATT & WHITNEY AIRCRAFT

DIVISION OF UNITED AIRCRAFT CORPORATION

EAST HARTFORD 8, CONNECTICUT

OUT OF THE BRIEFCASE

GAS TURBINES PUMP GAS

The most powerful concentration of gas turbines in the world will pump three hundred million cubic feet of gas back into the earth daily in Venezuela.

Built by Westinghouse Electric Corporation, twelve 8000-hp combustion gas turbines will be installed seven miles out on Lake Maracaibo, Venezuela, on a platform mounted on concrete pilings in 30 feet of water. They will drive centrifugal compressors which will inject natural gas from oil operations into the Maracaibo oil field, under high pressure.

This plant, built specifically for gas conservation, will recover substantial quantities of additional petroleum and conserve 120 percent more gas than its predecessor.

Eight of the turbine units will be directly connected to the centrifugal compressor, four will be geared. The twelve units will operate in two strings of six turbines each.

FASTEST ALL-WEATHER FIGHTER

Establishing a new milestone in Naval aviation history is the fastest all-weather Navy fighter now in service, the McDonnell F3H-2N Demon.

Led by Commander Walter Roach, Jr., USN, Commanding Officer of Fighter Squadron 14, six of these powerful fighters made the short flight from Naval Air Test Center, Patuxent River, Maryland, to the Naval Air Station, Jacksonville, Fla., placing the Demon officially on Fleet duty. Only a few hours later, the McDonnell Aircraft Corporation received a $55 million order for additional Demons from the U. S. Navy. Part of the order is for the all-weather version; the remainder is for production of a new missile-carrying Demon.

Of the tests on the carrier-based fighter, the Director of Service Test said: "The Demon Fleet Introduction Program was one of the most successful ever held at Patuxent."

The test program included catapult launchings, simulated carrier landings, night instrument flying, night intercepts, night formation flying and a full range of tactical maneuvers typical of combat fleet operation, at all altitudes from sea level to very high altitudes.

The new Demon is powered by the Allison J-71 turbojet engine, developed by General Motors Corporation. The thrust of this engine is further aided by the installation of an afterburner.

Due to its rapid-firing, high-velocity 20mm cannon and a large number of rockets and external store combinations, the new Demon is a formidable acrial weapon. Combining interceptor speed and fighter maneuverability with the weight of an attack bomber, the Demon will greatly strengthen the carrier groups of the U. S. Fleet.

The proposed Lake Maracaibo Gas Pumping Plant

Westinghouse Drawing

Electrical Roadblocks

Millions of tiny "electrical roadblocks," which increase the resistance of molded electrical insulation to electric arcs as much as 1000 percent, now can be built into the plastic-type material used for plugs, sockets, switches and the many other electrical devices for home and industry.

The process was developed by the Westinghouse Research Laboratories. The electrical roadblocks consist of sub-microscopic particles of an inert material such as silicon dioxide—common sand.

Resistance to arcing—when electricity "skips" across electrical insulation on or near its surface, causing a "short"—is an important requirement of electrical insulation. The new technique greatly improves the arc resistance of the most widely used types of molded insulating material by effectively breaking up the continuous path which is normally present for the electric arc to travel.

Besides silicon dioxide, a variety of other substances can be used for "roadblock" purpose. In addition to small size, their critical requirements are that they be stable at high temperatures and good electrical insulators themselves.

Westinghouse pointed out that the new technique was investigated at low levels of power, where a standard arc resistance test could be applied. Corresponding standardized tests at the high currents and voltages of large power-handling electrical apparatus have not yet been adopted.

Pocket Sized Solar Radio

General Electric announced the development of a pocket-sized solar radio receiver, capable of operating more than eight months in total darkness without recharging.

Its major advantages over previously developed solar-powered receivers are size—it weighs only 10 ounces—and length of operation without light. The latter quality is made possible by use of a miniature storage battery, contained in a transparent plastic case along with four transistors, seven solar cells, and other components. The case, 5½ by 4¼ by 3 inches, has only two control knobs.

Under normal daylight conditions, light rays strike the solar cells which convert solar energy to electricity. This energy travels directly to the transistors, powering the receiver, while the miniature storage battery works simultaneously to build up a supply of energy for use when sunpower is lacking. Artificial light, for example, a 100-watt lamp, may be used instead of sunlight.

Supersonic Dust Detector

Kodak has developed a highly sensitive dust-recording instrument, believed to be the fastest of its kind, as part of the company's continual war against impurities of air, in connection with their film manufacturing.

Within seconds the new instrument gives an accurate measure of dust conditions, simultaneously providing a continuous record of dust levels.

It is so sensitive that if a few thousandths of an inch of fine dust on the head of pencil are dispersed through an average room, 8 by 10 by 15 feet, the recorder will detect its presence.

(Please turn to Page 24)

By measuring the carbon dioxide generated by burning a steel sample in pure oxygen, this vacuum-fusion device can measure the carbon content of steel to within 5/10,000ths of a percent. U.S. Steel Photo.

WHAT ? **1956 ENGINEERS' BANQUET & BALL**

WHEN ? **SATURDAY, MAY 5, 1956**

WHERE ? **WASHINGTON ROOM HOTEL WASHINGTON**

WHO ? **ALL ENGINEERING STUDENTS & ALUMNI**

Sponsored by

ENGINEERS' COUNCIL

OF

THE GEORGE WASHINGTON UNIVERSITY
SCHOOL OF ENGINEERING

MUSIC BY SONNY SEIXAS

DINNER - DANCE 7 to 12 P.M. —— $10.00 Per Couple
DANCE — 9 to 12 P.M. —— $4.00 Per Couple
DINNER — 7 to 9 P.M. —— $4.50 Per Plate
DRESS OPTIONAL

Tickets may be purchased from

ALL ENGINEERING COUNCIL REPRESENTATIVES
THE UNIVERSITY BOOK STORE
THE DEAN'S OFFICE

THETA TAU

SIGMA TAU

A. S. C. E.

AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852

AIEE

IRE

A. S. M. E.

All over the world, technical "Minute Men" of the RCA Service Company assist the U. S. Army, Navy, Air Force.

How RCA "Minute Men" give added strength to our Armed Forces everywhere

At an Army camp in Northern Japan, RCA engineers check an outlying radar post. At an Air Force base in Florida, RCA specialists track a guided missile in flight. And at a Naval communication center in Guam, RCA technicians hurry to install a transmitter. All over the world, the technical "Minute Men" of the RCA Government Service Department are assisting our Armed Forces.

These "Minute Men"—experts in electronic installation, maintenance, and training—are backed by the RCA organization that provides the most complete electronic services and systems to the nation. Behind them stand RCA's 37 years of experience in communications and electronics; more than 70,000 RCA employees in manufacturing plants stretching from coast to coast; plus the fullest research facilities devoted to electronics that industry has ever known.

In all these ways, the RCA Government Service Department has proved its ability to give added strength to our Armed Forces in every part of the world.

RCA®

RADIO CORPORATION OF AMERICA

ELECTRONICS FOR LIVING

OUT OF THE BRIEFCASE

(Continued from Page 21)

The instrument resembles an ordinary vacuum cleaner, but unlike the cleaner, the dust detector blows the sucked-in air at supersonic speed against a thin, plastic sheet. Then a photoelectric "eye" reads the dust track thus deposited, for instrument measurement of its density. The resultant record of the dust record is permanently traced on graph paper.

With the additional attachment of a microscope, a scientist can make a swift preliminary examination of the dust trail by eye to gauge, for example, whether the magnified dust is lint or metallic in origin.

Also, the recorder effectively checks an air filtering system by sampling the air ahead of and behind the filters to show how much the filters are removing from the circulating air.

An early finding with the new equipment justifies a complaint long made by housewives: sometimes the dust level tends to rise in the area of a clean-up effort, and then subside to the same rather than to a lower level!

Color TV Is Here To Stay

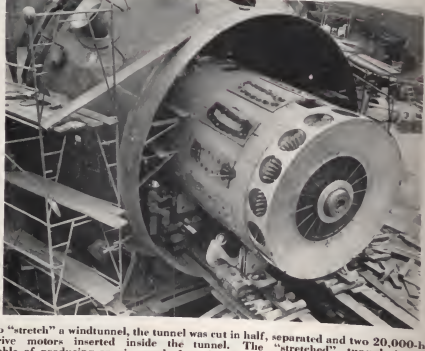
The era of color television is fast arriving, as evinced by the first TV plant completely converted for and geared to the mass production of color television receivers, by the Radio Corportion of America.

RCA is now geared to produce on each assembly line, a color TV set—completely tested, packed, and ready for shipment—at the rate of one-a-minute, at their Bloomington, Indiana plant.

RCA said that prices of color receivers will be adjusted downward as they take advantage of the economies of mass production.

Simultaneously, NBC has outlined its plans for continued expansion of color programming, noting that this winter's scheduled colorcasts will exceed by a multiplier of five the color programs carried last season. More and more local stations are equipped, or are installing equipment, to originate non-network programs.

To quote NBC's vice president, "By next fall, we expect that many of our principal evening attractions, in addition to the 90 minute Spectaculars, will be presented in color. Depending on how the schedule works out, it's entirely possible that between NBC and CBS, there will be important color programs on the air every day of the week, with several color shows on key evenings like Saturday and Sunday."



To "stretch" a windtunnel, the tunnel was cut in half, separated and two 20,000-hp drive motors inserted inside the tunnel. The "stretched" tunnel is capable of producing an air speed of mach 1.80. The tunnel, built by Westinghouse, is operated by the California Institute of Technology.

CAMPUS NEWS

SIGMA TAU

At the regular March meeting, Xi chapter initiated Doctor Ralph Edward Gibson, director of the Johns Hopkins University Applied Physics Laboratory. The initiation, held specially for honorary member Gibson, was attended by many faculty and honorary members of Xi Chapter. Present were W. Mayo-Wells, W. F. Roeser, R. Goetzenberger, B. C. Cruickshanks, and N. B. Ames. President Thomas Creswell presided over the ceremony; faculty advisor Prof. Cruickshanks presented the Sigma Tau Key.

AMES TO CEYLON

Professor Norman B. Ames, executive head of the electrical engineering department, has been awarded a Fulbright lectureship in electrical engineering at the University of Ceylon.

Professor Ames has asked for and been granted a year's leave of absence without pay by the University Board of Trustees. He will leave the University at the end of the present semester and take up his teaching duties at Ceylon about July 1.

Professor Ames has been on the faculty of the school of engineering for thirty-five years. He served his country in two world wars and now holds a reserve commission as full colonel in the Air Force.

Mrs. Ames plans to accompany her husband to Ceylon.

AIEE - IRE

A first year Physics book may give the definition of sound as "a disturbance which travels through a medium." The George Washington University chapter of the AIEE-IRE was treated to "disturbances" of the highest order at their regular monthly meeting held on March 7, 1956. The local chapter had as their guests Mr. Vincent Del Grosso, NRL; Mr. Stephen Hart, NRL; and Dr. Alfred Weissler, NIH.

These men conducted a symposium at which the aforementioned "disturbance" or subject was Ultra-Sonics. Mr. Del Grosso addressed the group on "Control and Testing of Liquids with Ultra-Sonics." Mr. Hart's topic was "Control and Testing the Solids with Ultra-Sonics" and Dr. Weissler spoke on "Chemical Effects of Intense Sound."

The field of Ultra-Sonics is in its infancy. However, much valuable data has been collected and many applications of Ultra-Sonics are being determined. It is believed that Ultra-Sonics will have countless applications in the field of medicine, a few of such applications being the determination of blood flow and vessel size and perhaps as a dissolver of blood clots. Other examples of the possible uses of Ultra-Sonic sound can be found in the fields of chemistry and manufacturing where it might be used for such things as regulating the rate of chemical reactions and for non-destructive testing.

On the following Monday, Mr. Del Grosso, Mr. Hart and Dr. Wiessler presented their symposium to the Washington Section of the IRE. The local chapter is grateful for being able to have had these men as their guests.

THETA TAU

March 17th was an eventful day for Gamma Beta chapter of Theta Tau. Gamma Beta was host to the regional convention, with fourteen delegates from Theta, Pi, Tau and Rho chapters attending. After a morning of discussion session, the hungry brothers adjourned to the Student Union for lunch and bull-sessions.

Early in the afternoon President Marvin spoke to the 50 odd assembled brothers welcoming the delegates to the George Washington University campus. Dr. Marvin revealed to the group, for the first time, the university's plans for a "time vault," in which items representing engineering in 1956 will be placed. The vault is to be opened in 2056.

Later in the afternoon, Gamma Beta chapter initiated Professor Benjamin Cruickshanks as an honorary member. Professor Cruickshanks, who is now executive head of the mechanical engineering department, is one of the senior members of the engineering faculty.

In the evening, the members, delegates and their wives and girls attended the fraternity's semi-annual Ball and Banquet at the Occidental Restaurant. At this event, new members Roy D. Brooks, Bob Donald, Dan Dreyfus, Charles Hunter, Arthur Koski, David Lewis, John Manning, Morrow Moore, Vincent Rider, Norman Street, Ray Sullivan, Earl Swann and Ado Valge were presented to the group. During the course of the night's festivities, the traditional judging of the new members' hand-made goats was held; John Manning's

(Please turn to Page 26)

CAMPUS NEWS

(Continued from Page 25)

precise hard-wood model won for him the prize of a pocket slide-rule. In keeping with the tradition that the new brothers should do something to entertain the old, a two-part skit was presented. The pseudo-t.v. program of "You Are There" included jibes at the entire membership of Gamma Beta worked in with a good deal of engineering and non-engineering humor. Of particular interest were the commercials for "Old George Instant Beer," which included a six foot fireball as proof of the alcoholic content of the sponsor's product.

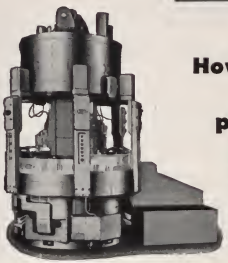
MECHELECIV

MECHELECIV was recently presented to the non-engineering students of George Washington in an article in the University paper entitled "Engineers Look for Humorists for Magazine."

The article cited the amazing growth of the magazine from a 4-page mimeographed sheet ten years ago to the 36 page colorfully bound magazine it is today. It further explained that the magazine is entirely produced by the engineering students at the University although non-engineering students may work on it in writing capacities.

It gave the purpose of the magazine as bringing readers up to date on activities in the world of engineering and also stated the amazing fact that the magazine is entirely self-supporting. The article concluded by saying that the magazine would be glad to welcome any newcomers with writing talent to its staff.

Another page for **YOUR BEARING NOTEBOOK**



How to locate shafts accurately on high-speed precision chucking machine

Engineers designing the new Bullard Mult-Au-Matic Type "L" vertical chucking machine were faced with the problem of achieving high precision despite heavy work loads and high speeds. To do this, they used Timken® tapered roller bearings to furnish the precision and load-carrying capacity required at the locating position.

Full line contact gives Timken® bearings extra load capacity

Because the load is carried along a full line of contact between rollers and races, Timken bearings have extra load-carrying capacity. And their tapered construction permits them to take radial and thrust loads in any combination. Result: shafts are held in rigid alignment, shaft deflection and end play are minimized, gears mesh smoothly, spindle precision is assured at high speeds.

Want to learn more about bearings or job opportunities?

Some of the engineering problems you'll face after graduation will involve bearing applications. For help in learning more about bearings, write for the 270-page General Information Manual on Timken bearings. And for information about the excellent job opportunities at the Timken Company, write for a copy of "This Is Timken". The Timken Roller Bearing Company, Canton 6, Ohio.

TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
TAPERED ROLLER BEARINGS

NOT JUST A BALL ○ NOT JUST A ROLLER ⊂ THE TIMKEN TAPERED ROLLER ⊂
BEARING TAKES RADIAL ∮ AND THRUST ⊣○⊢ LOADS OR ANY COMBINATION ✳

FACULTY PAGE

(Continued from Page 9)

istrators and what might be called social engineers. They can become more human, culturally and socially. One piece of evidence to indicate this is the results accomplished in the course *Engineer and Society* (*EA* 205) in the Engineering Administration Program of the School of Engineering here at George Washington. This course emphasizes the role and impact of engineers upon society in raising the standard of living through the provision of power and light, water, manufacturing, transportation, and other engineering activities. The effect which society has upon the engineer is discussed. For example, the question "How should Art and Religion affect the engineer?" is asked. During the course these engineers spend some time at the Phillips Gallery and in class discussing contemporary or modern art. After these sessions, the class was challenged to produce something artistic on an engineering subject, such as Einstein's formula, $e = mc^2$. Two men in the class, Mayo-Wells and Gustilo, came up with, respectively, a poem and a painting, which are illustrated in this article. If engineers would put some time and effort on cultural and social problems, I believe that they could be more productive and of more benefit to society. Engineering and society can be more congenial. They can be social as well as technical. Engineering can be artistic as well as useful.

The "social" engineer can help build finer social values while developing better machines, structures and a higher standard of living.

Keep 'Em Rollin'

(Continued from Page 17)

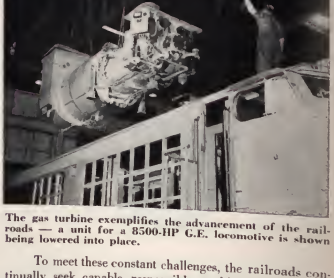
New developments continue to offer substantial economies. The use of high strength bolts in lieu of rivets is a case in point. One man with a hand wrench can replace a small number of loose or defective rivets in maintenance work much more economically than a large steel gang and heavy equipment.

The expense of centralized traffic control replacing line operators or towermen can be more readily financed today from the savings of the higher rates of pay in effect.

Safety enters into the challenge of economization. Records show that intangible and incidental costs due to lost time, broken machines and injuries due to accidents cost the railroads an average of $4.00 for every dollar paid out in compensation and medical care. The engineer can reduce these costs by striving to reduce hazardous operations through ideas for better and safer machines and methods.

In construction work, the engineer should realize that money is saved at the drafting board and not in the field. Advantage should be taken of the new building materials developed, flexibility in building design and advanced methods of construction.

In a great many instances, there are several solutions to the problem; therefore, the engineer should study each solution thoroughly and select the best plan, giving consideration to the solution that meets the needs and affords the most economy in construction, maintenance and operation. The engineer must not be misled by out-of-pocket costs or immediate savings - he must be guided by the principle of overall economic costs.



The gas turbine exemplifies the advancement of the railroads — a unit for a 8500-HP G.E. locomotive is shown being lowered into place.

To meet these constant challenges, the railroads continually seek capable, responsible, ambitious, aggressive young graduate engineers. Capable - to meet the challenge of modernization. Responsible - to overcome the challenge of economization. Ambitious - to seek the challenge of administration. Aggressive - to thwart the challenge of competition. Thus, the railroads, one of the largest industries in the nation today, face these challenges and continue to "Keep 'em rollin'."

ALUMVIEWS

PRESIDENT'S MESSAGE

By Warren C. Crump

President, Engineers' Alumni Association

The months of April and May find members of the Engineer Alumni Association thinking more about their Alma Mater than at any time in recent years. What's more, we're doing as well as thinking.

You have by now received your copy of the Engineer Alumni Directory. I hope that you will send any of your reactions, suggestions or corrections to me in care of the University's alumni office. This should be a most valuable addition to your library.

You have - - or will soon have - - heard from one of your fellow alumni concerning the Alumni Fund which has given Engineering graduates the opportunity to assist in the furnishing of the new Tompkins Hall of Engineering, our school's future home. The returns to a special mailing to Engineer graduates from your Association and a notice from the General Alumni Association have been most gratifying.

However, it is the personal solicitation phase of the campaign, centered in the Washington metropolitan area, that is gaining the support of so many of your fellow graduates. Fund Deputy Chairmen include Norman Ames, Bill Roeser, Ben Leatherwood, Bob Lathrop and Paul Conner. Under their leadership, each non-contributor in the Washington Metropolitan area has been or will be contacted personally in behalf of the Fund. I hope that each of us cooperates in this important venture.

Finally, we're making plans for another outstanding Annual Luncheon of the Engineer Alumni Association in May. I hope that you will watch for the notice of the date and place and will be sure to be on hand at this yearly reunion of graduates of the School of Engineering.

ALUMNI NOTES

By the Alumni

James L. Martin (BCE '50; Sigma Tau) is employed by the Federal Government, State of California, and City of Richmond, California. He is now the Assistant City Engineer for the City of San Leandro, California. He is married and has two daughters.

Lawrence E. Laubscher (BEE '52; LLB. '55; Sigma Tau) has recently received his law degree and is associated with the Patent Law Firm of Pierce, Scheffler & Parker in Washington, D. C. He is married and now has two children.

Murray Berdick (B.S. In Engineering '42; Sigma Tau; Pi Delta Epsilon, Omicron Delta Kappa) is the Coordinator of Research at Evans Research and Development Corporation, New York, Consulting Chemists. He has held his job since he finished his work for a Ph.D. in Chemistry at the Institute of Polymer Research, Polytechnic Institute of Brooklyn, in 1953. He has recently become the father of a little girl, Dena Anne Berdick.

Joaquin L. Panis (BSCE '25) is the President of the Southwestern Construction Company, and is a member of the Board of Aldermen, Cebu City, Philippines. His son, Victor, expects to enroll in the School of Engineering next fall.

TO: ALUMNI EDITOR
Mecheleciv Hagazine
The Davis-Hodgkins House
The George Washington University
Washington 6, D. C.

From: _____

_____

_____

Here are a few comments for ALUMVIEWS on where I'm working, what I'm doing and news of my family.

_____

_____

_____

_____

Degree and Date _____ **Fraternity** _____

INSTRUMENT MAKING

(Continued from Page 11)

With the facilities of the Alpha shop, repair, overhaul, and calibration is provided not only for surveying instruments, but for other instruments of optical and mechanical precision useful in almost every branch of science and engineering.

Alpha has an arrangement with Bausch and Lomb to perform the overhaul, repair and adjustment of microscopes in the Washington area. Repair work is frequently done on marine compasses, portable and precise barometers, and on telescopes of many descriptions.

Often special applications of instruments require their adaptation. The experience and instrument knowledge of the personnel of an instrument shop is applied in consultation with a client before designing a modification to fit a special need.

A stock of reconditioned instruments has been accumulated by Alpha as a natural by-product of its operations. These are mostly surveying instruments reconditioned for resale or rental after having been traded in by purchasers of new equipment.

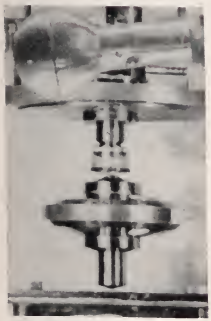
A major development of Alpha is in the direction of more design, development, and construction of special precision and measuring instruments. Recently, a dividing head for checking the tap positions of precision potentiometers was designed and constructed. This instrument has been further developed for application in any field where precise measurement or translation of angles is desired.

An important part of the design and construction work of Alpha has been that of instruments for astronomical observatories. In the Spring and Summer of 1955, five equatorial astronomical camera telescopes were designed and constructed for the Georgetown College Observatory. Each telescope has an objective lens of 5½ inches aperture and 80 inches focal length and is synchronous-motor driven to compensate the rotational motion of the earth in tracking an astronomical object. In addition, each instrument has an electrically synchronized shutter and camera magazine capable of changing a plate and making an exposure every five seconds. The camera mechanism automatically registers the instant of exposure on a tape recording by superposition of an oscillator signal with simultaneously-recorded continuous radio time signals. The completed instruments were erected and tested at Alpha and then turned over to the Georgetown College Observatory. The five units were then transported to different places in Africa and Asia to be erected in an expedition led by Father Heyden, the Observatory Director. The expedition was undertaken under U. S. Air Force contract to make a photographic-time record of the annular solar eclipse of December 14, 1955 at selected stations along its path.

The purpose of the astronomical data taken by these special telescopes was not merely to correlate the solar eclipse phases with time and location, but to make a vast *measurement* — a redetermination of the size and shape of the earth.

THE TURBO ENCABULATOR

(Editor's note: This article originally appeared in the Industrial Bulletin of Arthur D. Littell, Inc., and subsequently appeared in the May, 1954 issue of MECHELECIV. For those unfortunate students of the sciences who missed this article in its first publication, this reprint is dedicated. In spite of the precise terminology and advanced standing of this article, the editors of MECHELECIV feel that it lies within the comprehension of all students of engineering. The author of this paper, for only too obvious reasons, preferred to remain anonymous.)



The Turbo-Encabulator

For a number of years now, work has been proceeding in order to bring perfection to the crudely conceived idea of a machine that would not only supply inverse reactive current for use in unilateral phase detractors, but would also be capable of automatically synchronizing cardinal grammeters. Such a machine is the "Turbo-Encabulator." Basically, the only new principle involved is that instead of power being generated by the relative motion of conductors and fluxes, it is produced by the modial interaction of magneto-reluctance and capacitive directance.

The original machine had a baseplate of prefabulated amulite, surmounted by a malleable logarithmic casing in such a way that the two spurving bearings were in a direct line with the pentametric fan. The latter consisted simply of six hydrocoptic marzelvanes, so fitted to the ambifacient lunar wane-shaft that side fumbling was effectively prevented. The main winding was of the normal lotus-o-delta type placed in panendermic semi-boloid slots in the stator, every seventh conductor being connected by a non-reversible tremie pipe to the differential girdlespring on the "up" end of the grammeters.

Forty-one manestically spaced grouting brushes were arranged to feed into the rotor slip-stream a mixture of high X-value phenylhydrobenzamine and 5 per cent reminative tetryliodohexamine. Both of these liquids have specific pericosities given by

$$P = 2.5C \frac{P - 7}{n}$$

Where n is the diathetical evolute of retrograde temperature phase disposition, and C is Cholmondeley's annual grillage coefficient. Initially, n was measured with the aid of a metapolar refractive pilfrometer (for a description of this ingenious instrument, see L. E. Rumpelverstein in "Zeitschrift fur Elektrotechistatischs-Donnerblitze," vol. vii), but up to the present date nothing has been found to equal the transcendental hopper dadoscope. (See "Proceedings of the Peruvian Academy of Skato-logical Sciences," June, 1914.)

Electrical engineers will appreciate the difficulty of nubing together a regurgitative purwell and a supramitive wennel-sprocket. Indeed, this proved to be a stumbling block to further development until, in 1942, it was found that the use of anhydrous nangling pins enabled a krytonastic bolling shim to be coupled to the tankoid.

Early attempts to construct a sufficiently robust spiral decommutator failed largely because of a lack of appreciation of the large quasi-piestic stresses in the garvin studs; the latter were specially designed to hold the roffit bars to the spar-shaft. When, however, it was discovered that wending could be prevented by a simple addition to the reeving sockets, almost perfect running was secured.

The operating point is maintained as near as possible to the n.f. rem peak by constantly fromaging the bitumogenous spandrels. This is a distinct advance on the standard nivelsheave in that no dram-cock oil is required after the phase detractors have remissed.

Undoubtedly, the turbo-encabulator has now reached a very high level of technical development. It has been successfully used for operating nofer trunnions. In addition, whenever a barescent skor motion is required, it may be employed in conjunction with a drawn reciprocating dingle arm to reduce sinusoidal depleneration.

Slipstick Slapstick

The young engineer started to work as a draftsman. Within six months he was made head of the department. In another six months he was put in charge of all research and design, and shortly thereafter he was made general manager.

A few days later he was called in by the president of the firm who explained that he would retire soon and would turn the presidency over to the newcomer.

"Thanks," said the young man.

"Thanks!" growled the president. "You've been with this firm only a year and that's all you can think of to say?"

"Well," said the young man, "thanks a lot, Dad."

* * *

Physics 132 Prof.: "Who's smoking in the back of the room?"
M.E.: "No one, that's just the fog we're in."

* * *

Do you suffer from acid indigestion? You do? Then stop drinking acid.

* * *

"Shay, Lady, you're the homeliest woman I ever saw."
"Well, you're the drunkest man I ever saw."
"I know, Lady, but I'll get over it in the morning."

* * *

A young man addressed a letter to another young man pointing out that he understood the second fellow had been taking his engaged girl out. He requested that the offender call at his home and talk the matter over. Two days later he received this reply: "Received your circular letter. Will be at the meeting."

Two junior sized "cats" were loitering on the street corner when one said to the other.
"How old is you?"
"Ah's five. How old is you?"
"Ah don't know."
"You don't know how old you is?"
"Nope."
"Does women botha you?"
"Nope."
"Youse fo'."

* * *

Father to Daughter: Your young man approached me and asked for your hand and I consented.
Daughter: But Father, I don't wish to leave mother.
Father: Such feeling displayed by a child is a admirable. Take your mother with you.

* * *

HE: "What would you think if I stole a kiss?"
SHE: "What would you say to a guy who had a chance to steal an automobile but only took the windshield wiper?"

* * *

Last summer at one of the ROTC summer camps in the deep South, one of the cadets was sent down to a stream near the camp to get some drinking water for the platoon. but had not been gone long when he came running back to camp empty-handed.

"Sir," he exclaimed, "there's a big alligator in the stream and I'm afraid to get the water."

"Don't worry son," said the officer, "that alligator is probably four times as scared of you as you are of him."

"Well, sir," replied the cadet, "If that alligator's only half as scared as I am, that water ain't fit to drink."

A professor sought admission to the pearly gates.
"Who are you?" Saint Peter asked.
"I am a college professor."
"What do you want?"
"I want to get in."
"What have you done that entitles you to admission?"
"Well, I saw a decrepit old senior on campus the other day and I gave him two cents."
"Gabriel, is that on the records?"
"Yes, Saint Peter."
"What else have you done?"
"Well, the other night I gave a starving freshman a penny."
"Gabriel, is that on the records?"
"Yes, Saint Peter."
"Well, Gabriel, what do you think we ought to do with this guy?"
"Give him back his three cents and tell him to go to hell."

* * *

Prof.: "Why don't you answer when I call your name?"
Sam M.: "I nodded my head."
Prof.: "You don't expect me to hear the rattle way up here do you?"

* * *

Mr. Welles: "If, in going down this incline, I gain four feet per second, what will be my condition after 25 seconds?"
Dick B.: "You'll be a centipede."

* * *

The ones who think our jokes are rough
Would quickly change their views,
If they'd compare the ones we print
With the ones we're scared to use.

F4D, "SKYRAY"— only carrier plane to hold official world's speed record

A4D, "SKYHAWK"— smallest, lightest atom-bomb carrier

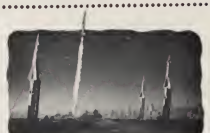
RB-66— speedy, versatile jet bomber

A3D, "SKYWARRIOR"— largest carrier-based bomber

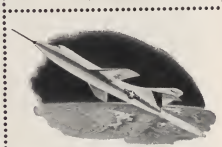
C-124, "GLOBEMASTER"— world's largest production transport

DC-7 "SEVEN SEAS"— America's finest, fastest airliner

Engineers: join this winning team!



"NIKE"— supersonic missile selected to protect our cities



D558-2, "SKYROCKET"— first airplane to fly twice the speed of sound

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Torsion Bar

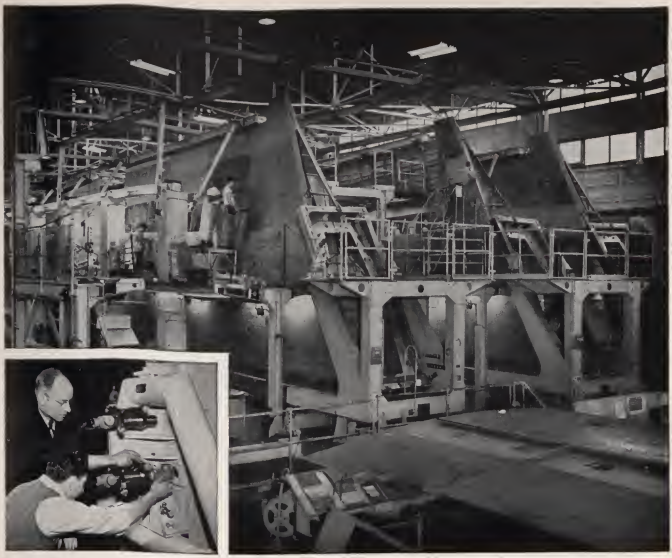
(Continued from Page 13)

There are, of course, limitations to the amount of work that the levelizer should do. First of all, the electric motor would soon wear out if it reacted to every change in the car's level. To prevent the motor from running every time the car strikes a bump, the control switch has a six-second delay before it starts the motor. Since braking is improved by a forward shift of weight, the compensator is cut out when the brakes are applied. The compensator also has a manual control switch so that it can be turned off when the tires are being changed. The combination of front-to-rear wheel linkages and a load compensator with automatic controls makes the Packard actually anticipate the road ahead.

The Packard ride is free of practically every annoyance of conventional springing. Because of the levelizer, caster angle for steering remains constant, and the headlight aim is always the same regardless of how much luggage is in the trunk. The interconnection of front and rear wheels by torsion bars also has many advantages. Body squat when the car starts off is limited. Dive and pitch when the car is stopped quickly is reduced. On curves, the outside rear wheel carries a load equal to that carried by the front wheel. Therefore, the traction is improved, and cornering is safer and better controlled. Also the amount of body lean on curves is decreased. The torsion bar linkage eliminates the twisting of the body and frame when the car is driven across washboard bumps and railroad tracks, and the rear torque arms improve traction by bearing on the rear axle during acceleration.

The only disadvantages of the Packard torsion bars are minor matters of weight, cost, and maintenance. The torsion bar system increases the car's weight by about 100 pounds which is an insignificant amount on a 4300-pound car. The added cost of torsion bars is about $150, or less than the cost of an automatic transmission. The torsion bars themselves should last as long or longer than conventional springs, but the compensator or its switches may be subject to occasional failures of minor expense. However, these small faults are trifling in comparison with the improved riding and handling qualities that the torsion-bar-equipped Packard offers.

When torsion bars were introduced last year, they were available only on the Packard and Clipper Custom series. This year they are being offered on all series of the Clipper as well as the Packard. Furthermore, the use of torsion bars is likely to spread in this country as the need for better suspension systems becomes more acute. One manufacturer is now developing a levelizing system similar to Packard's which will be used with a conventional coil spring system. The development of Packard's torsion bars and levelizer has been a great step toward the solution of the automobile suspension problem.



Boeing production engineering—precision on a big scale

This Boeing B-52 wing jig is one of a battery of four. Each one is 90 feet long and weighs more than 1,000 tons. Yet many of its tolerances are within 1/1000 of an inch—as close as a fine watch! Almost-absolute accuracy on a tremendous scale like this means that Boeing production engineers face some of the most stimulating challenges in engineering today.

These production engineers are of many types. And, because of steady expansion, Boeing needs more of them: industrial, civil, mechanical, electrical and aeronautical engineers.

There is "growing room" for topnotch production engineers at Boeing's Wichita and Seattle plants. Big programs are now under way on the airplanes and guided missiles of a few years hence. And Boeing production engineers are responsible for the high quality and continuous development of such industry-leading airplanes as the B-52—famous "Long Rifle" of Strategic Air Command—and the 707—the world's first jet tanker-transport.

At Boeing, production engineers find individual recognition in tightly integrated teams in design-analysis, test, and liaison-service. They find that Boeing is an "engineers' company," with a long-standing policy of promotions from within the organization.

Career stability and growth are exceptional at Boeing, which now employs more than twice as many engineers as at the peak of World War II. Boeing engineers enjoy a most liberal retirement plan. And life for them is pleasant in the progressive, "just right" size communities of Seattle and Wichita.

There are opportunities at Boeing in design and research, as well as in production. If you want job security, satisfaction and growth, it will pay you to investigate a Boeing career *today*.

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From The Editor's Notebook

The pains of growth are always the greatest when the expansion is large with respect to the original size. With this as a criteria, MECHELECIV is in agony; last year's issue of this month was 24 pages, and this is 36. When 2400 issues are stacked on circulation manager *Paul Goozh's* desk, we can't see Paul, even if he stands on the desk. After tripping over a pile of engravings for the third time in one day, office manager *Vince Rider* started eyeing the back room in the D-H house as a solution to our overcrowded quarters.

Theta Tau reigned on last St. Pat's day, and MECHELECIV was well represented. *Vince Rider, Norm Street* and *Ray Sullivan* were initiated into Gamma Beta Chapter. After seeing the new members' skit, yours truly, the editor, complimented associate editor Sullivan for his cunning in the use of jokes from our exchange E. C. M. A. file. Not to be outdone by the male contingent, chief copy reader *Marilyn Lott* appeared on the scene to share in the festivities.

Upon seeing our rejuvenated joke page, Theta Tau Regent *Matt Foster* chuckled, complimented y. t. on his editorial taste (actually Sullivan did it); and suggested that a full page pin-up be included in the next issue.

New Additions Dept.: *Lenore Alexander*, who did last month's cover, is a direct steal from the Columbian College. Upon seeing the actual product, Lenore confided in y. t. that the color of the cover happened to be the only paint she had had on hand for the dummy; however we think it came out quite well. One day while y. t. was peacefully eating his lunch, *Jim Jennings* rushed in with the expressed desire of working on the magazine. After the initial shock had worn off, Jim was put to work on the files and will be working in circulation.

Afraid, so to speak, of working a willing horse to death, y. t. was cautious in assigning work to *Bobby Holland*. Bobby contributes quite freely of her time and energy to this publication, for which the editors are duely thankful.

While working in the communications lab one day, *Mr. Don Hanrahan* of the E. E. department admitted to being a proud father of a little girl -- for the third time; Cathleen Frances, weighing 6 lbs. 1 oz. at her arrival, appeared on March 9. We really have to snoop to get such dope on the faculty . . .

Unfortunately, *Theresa Koontz* is unable, due to illness, to present her article in this issue. The entire staff sincerely wishes you a speedy recovery, Theresa.

IN OUR NEXT ISSUE: Being the May issue, our graduates will take the top billing. *Gope Hingorani* will give us a glimpse of how engineers live and work in his native India.

In the Arma Visual Computer, a single control selects the desired chart from as many as 700 photo slides. Each slide contains punched code holes which automatically tune in the corresponding Omni Bearing Distance station. The image of the plane is governed by a combination of the radio signals and the plane's gyro instruments.

Photography teams with electronics and adds new certainty to flight

Now a visual computer pictures a plane's precise position and heading on projected photos of aeronautical maps.

Arma Division, American Bosch Arma Corp., working with the Air Navigation Development Board and C.A.A., has developed a valuable new aid in air navigation using photography.

With it the pilot, high above the weather, flicks a switch and before him appears a map of the area he's over. On the screen a tiny shadow of a plane moves and shows exactly where he is, where he's heading and whether he's on course.

This spells added certainty. Even more! It can mean savings in time and money, too. For the flight can proceed by plan rather than by dog-legs on the beams.

So again we see photography at work helping to improve operations—doing it for commercial aviation just as it does for manufacturing and distribution.

Photography works in many ways for all kinds of business, large and small. It is saving time, saving money, bettering methods.

This is why graduates in the physical sciences and in engineering find photography an important tool in their new occupations. Its expanding use has also created many challenging opportunities at Kodak, especially in the development of large-scale chemical processes and the design of complex precision mechanical-electronic equipment. If you are interested in these opportunities, write to Business and Technical Personnel Department, Eastman Kodak Company, Rochester 4, N. Y.

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*ILLUSTRATION: *Sales Engineer and customers discuss turbine rotor construction. Glasses are factory safety measure.*

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